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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to nonaqueous electrolyte excellent in the charging and discharging characteristic, and the rechargeable battery using it. It is related with nonaqueous electrolyte suitable for the lithium secondary battery which contains the anhydride of sulfonic acid and carboxylic acid in details more, and the rechargeable battery using it.

[0002]

[Background of the Invention]The cell using nonaqueous electrolyte is high tension, and has high energy density.

Since reliability, such as keeping, is high, it is widely used as a power supply of consumer electronics.

[0003]There is a nonaqueous electrolyte secondary battery as such a cell, and the typical existence is a rechargeable lithium-ion battery. As a nonaqueous solvent used for it, the carbonate compound with a high dielectric constant is known, and use of various carbonate compounds is proposed. As an electrolysis solution, said high permittivity carbonate compound solvents, such as propylene carbonate and ethylene carbonate, The solution which mixed electrolytes, such as LiBF_4 , LiPF_6 , LiClO_4 , LiAsF_6 , LiCF_3SO_3 , and Li_2SiF_6 , is used for the mixed solvent with low viscosity solvents, such as diethyl carbonate.

[0004]On the other hand, research of the electrode is also advanced aiming at high-capacity-izing of a cell, and the occlusion of lithium and the carbon material which can be emitted are used as a negative electrode of a rechargeable lithium-ion battery. Since it has the features, like discharge potential is flat and there is, especially high crystallinity carbon, such as black lead, is adopted as a negative electrode of most rechargeable lithium-ion batteries marketed now.

[0005]However, when using high crystallinity carbon, such as black lead, for a negative electrode, as a nonaqueous solvent for electrolysis solutions, If the propylene carbonate which is a low high dielectric constant solvent of a coagulating point, and 1 and 2 **BUCHIREN carbonate are used, The reductive cleavage of a solvent occurs at the time of first time charge, the insertion reaction to black lead of the lithium ion which is an active material becomes difficult to advance, and, as a result, decline in first-time charge and discharge efficiency and the fall of the load characteristic of a cell take place.

[0006]For this reason, as a nonaqueous solvent of the high permittivity used for an electrolysis solution, although it is a solid at ordinary temperature, when reductive cleavage mixes the ethylene carbonate which does not happen easily continuously to propylene carbonate, the trial which suppresses the reductive cleavage of a nonaqueous solvent is made. In order to improve the viscosity characteristic of a nonaqueous solvent furthermore in addition to control of reductive cleavage, devising how with a low viscosity solvent to combine, adding various additive agents, or restricting the content of the propylene carbonate in an electrolysis solution etc. is proposed.

[0007]Although improvement in the charging and discharging characteristic of a cell has been achieved by these measures, The fall of the load characteristic of a cell and the fall of cell capacity resulting from the very small reductive cleavage at the time of repeating high temperature preservation and a charging and discharging cycle, for example are improved, and the electrolysis solution which improves the low-temperature characteristic further is called for.

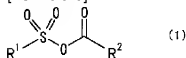
[0008]

[Problem(s) to be Solved by the Invention]An object of this invention is to provide the electrolysis solution in which the decomposition reaction of the solvent on a negative electrode is inhibited, and degradation of the load characteristic of a cell is controlled even if it performs high temperature preservation. It aims at offer of the nonaqueous electrolyte which gives a load characteristic and the low-temperature characteristic excellent in the cell. It aims at offer of the rechargeable battery containing this nonaqueous electrolyte.

[0009]

[Means for Solving the Problem]This invention provides nonaqueous electrolyte which consists of a nonaqueous solvent containing an anhydride of sulfonic acid and carboxylic acid by which it is expressed with a following general formula (1), and an electrolyte.

[Formula 5]

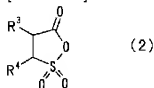


(R¹ in a formula and R² may be the same, or may differ from each other, and are an organic

group of the carbon numbers 1-10.) R^1 and R^2 may be combined mutually.

[0010] Nonaqueous electrolyte whose anhydride of said sulfonic acid and carboxylic acid is a compound expressed with a following general formula (2) is a desirable mode of this invention.

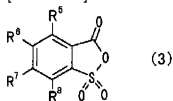
[Formula 6]



(R^3 in a formula and R^4 may be the same, or may differ from each other, and are an organic group of hydrogen, halogen, or the carbon numbers 1-10.)

[0011] The nonaqueous electrolyte whose anhydride of said sulfonic acid and carboxylic acid is a compound expressed with a following general formula (3) is a desirable mode of this invention.

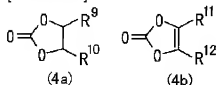
[Formula 7]



(R^5 in a formula - R^8 may be the same, or may differ from each other, and are an organic group of hydrogen, halogen, or the carbon numbers 1-10.)

[0012] The aforementioned nonaqueous electrolyte which is that in which the aforementioned nonaqueous solvent contains the anhydride of said sulfonic acid and carboxylic acid and at least one sort chosen from the cyclic carbonate expressed with a following general formula (4a) or (4b) and/or chain carbonic ester is also a mode with preferred this invention.

[Formula 8]



(Into a formula (4a) (4b), R^9 - R^{12} may be the same, or may differ from each other, and are an alkyl group of a hydrogen atom or the carbon numbers 1-6.)

[0013] This invention provides the rechargeable battery containing the aforementioned nonaqueous electrolyte.

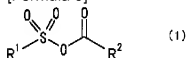
[0014]Furthermore, this invention as negative electrode active material Metal lithium, a lithium content alloy, Or the carbon material in which the dope and dedope of a lithium ion are possible, the tin oxide in which the dope and dedope of a lithium ion are possible, Titanium oxide in which the dope and dedope of a lithium ion are possible, niobium oxide, vanadium oxide or the silicon in which the dope and dedope of a lithium ion are possible, and the negative electrode containing whether it is ***** , The rechargeable lithium-ion battery containing the anode which contains either a transition metal oxide, transition metal sulfide, the multiple oxide of lithium and a transition metal, a conductive polymer, carbon materials or these mixtures as positive active material, and the aforementioned nonaqueous electrolyte is provided.

[0015]

[The concrete gestalt of invention implementation] The nonaqueous electrolyte concerning this invention and the rechargeable battery using this nonaqueous electrolyte are explained concretely. The nonaqueous electrolyte concerning this invention consists of a nonaqueous solvent containing the anhydride of sulfonic acid and carboxylic acid, and an electrolyte, and explains the each in full detail.

[0016]As an anhydride of sulfonic acid, sulfonic acid which a nonaqueous solvent is made to contain by anhydride this invention of carboxylic acid, and carboxylic acid, a compound expressed to a general formula (1) is illustrated.

[Formula 9]



[0017]Among a formula (1), R^1 and R^2 may be the same, or may differ from each other, and are an organic group of the carbon numbers 1-10. R^1 and R^2 may be combined mutually.

[0018]As an organic group, a hydrocarbon group, a halogenated hydrocarbon group, the hydrocarbon group containing a hetero atom, the halogenated hydrocarbon group containing a hetero atom, etc. are mentioned. Oxygen, nitrogen, sulfur, Lynn, boron, etc. are mentioned as a hetero atom.

[0019]When the example of the organic group of the above-mentioned carbon numbers 1-10 is given, as a hydrocarbon group, A methyl group, an ethyl group, a propyl group, an isopropyl group, a butyl group, a sec-butyl group, t-butyl group, 1-methylenepropyl group, a pentyl group, 1-methylbutyl group, 2-methylbutyl group, 3-methylbutyl group, a 1-methyl-2-methylpropyl group, Alkyl groups, such as a 2,2-dimethylpropyl group; A vinyl group, 1-propenyl group, 2-propenyl group, 1-butenyl group, 2-butenyl group, 3-butenyl group, Alkenyl groups, such as a 2-methyl-2-propenyl group, a 1-methyl-2-propenyl group, and a 1,2-

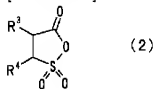
dimethylvinyl group; An ethynyl group, Alkynyl groups, such as 1-propynyl group, 2-propynyl group, 1-butynyl group, 2-butynyl group, and 3-butynyl group; aryl groups, such as a phenyl group, a methylphenyl group, an ethyl phenyl group, a vinyl phenyl group, and an ethynyl phenyl group, can be raised.

[0020]As a halogenated hydrocarbon group, a trifluoromethyl group, a trifluoroethyl group, Alkyl halide groups, such as a pentafluoroethyl group; aryl halide groups, such as a fluorovinyl phenyl group, a fluoroethynyl phenyl group, a fluorophenyl group, a difluoro phenyl group, a trifluoro methylphenyl group, and a chlorophenyl group, can be mentioned.

[0021]A fluoro methoxypheny group, a difluoro methoxypheny group, etc. can be illustrated as a halogenated hydrocarbon group containing a hydrocarbon group containing a hetero atom or a hetero atom.

[0022]An anhydride of sulfonic acid and carboxylic acid which have the structure which R^1 and R^2 combined in said general formula (1) can also be used conveniently. A compound expressed with the following general formulas (2) as an example of such a compound can be illustrated.

[Formula 10]



[0023] R^3 in a formula and R^4 may be the same, or may differ from each other -- hydrogen, halogen, or a carbon number -- 1-20 -- it is an organic group of the carbon numbers 1-10 preferably. R^3 and R^4 may combine with each other, and may form the ring. As an organic group, a hydrocarbon group, a halogenated hydrocarbon group, the hydrocarbon group containing a hetero atom, the halogenated hydrocarbon group containing a hetero atom, etc. are mentioned. Oxygen, nitrogen, sulfur, Lynn, boron, etc. are mentioned as a hetero atom. The basis same as a desirable example of the organic group of the carbon numbers 1-10 as having described above can be mentioned.